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A Riemann manifold Hamiltonian Monte Carlo (RMHMC) for binary neutron star parameter estimation.

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The Hamiltonian Monte Carlo (HMC) is a sampling algorithm that eliminates a random walk in parameter space by applying Hamilton's equations on the position and momentum of a fiducial particle. In this way, one is able to explore the posterior in a very efficient way, since information from the posterior is directly used to compute the
dynamics of the particle at each step in its trajectory. In general, the HMC converges D times faster than a standard Markov Chain, where D is the dimensionality of the parameter space. However, efficiency comes at a cost since each Hamiltonian trajectory requires multiple numerical calculations of the gradient of the log-likelihood that can make the computational cost explode, hence making this method less competitive compared to other sampling methods. By using information from the topology of the parameter space, and an analytic approximation to the gradients, we propose an application of the HMC algorithm for the parameter estimation of binary neutron star coalescence in the context of ground-based gravitational waves data analysis that now runs on an acceptable timescale.

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